elegant net-work of sarcode with wide oval and round meshes radiating irregularly from a central point. The membrane is traversed by irregularly radiating ridges of firmer substance, which unite in the centre in a projecting boss at the point where, in this specimen, the "glass-rope" has unfortunately been torn out.

WYVILLE THOMSON

(*To be continued.*)

THE ANCESTRY OF INSECTS

WITHIN a very few days after my last article on the "Origin and Metamorphoses of Insects" appeared in NATURE, I received from Mr. Packard a memoir,* under the above title, in which he developes his latest views on the same subject; and I am happy to find that his views do not differ so much from mine as I had supposed. He lays great stress, as is natural, on the larval forms. "If we compare," he says, "these early stages of mites and myriopods, and those of the true six-footed insects, as in the larval Meloë, Cicada, Thrips, and Dragon-fly, we shall see quite plainly that they all share a common form. What does this mean? To the systematist who concerns himself with the classification of the myriads of different insects now living, it is a relief to find that all can be reduced to the comparatively simple forms sketched above. It is to him a proof of the unity of organisation pervading the world of insects. He sees how Nature, seizing upon this archetypal form has, by simple modifications of parts here and there, by the addition of wings and other organs wanting in these simple creatures, rung numberless changes in this elemental form." And again (p. 151), "Going back to the larval period, and studying the insect in the egg, we find that nearly all the insects yet observed agree most strikingly in their mode of growth, so that, for instance, the earlier stages of the germ of a bee, fly, or beetle, bear a remarkable resemblance to each other, and suggest again, more forcibly than when we examine the larval condition, that a common design or pattern pervades all."

He distinguishes, as in his previous writings (p. 175), two principal types of larvæ:—

"There are two forms of insectean larvæ which are pretty constant. One we call leptiform, from its general resemblance to the larvæ of the mites (Leptus). The larvæ of all the Neuroptera, except those of the Phryganeidæ and Panorpidæ (which are cylindrical, and resemble caterpillars), are more or less leptiform, *i.e.*, have a flattened or oval body, with long thoracic legs. Such are the larvæ of the Orthoptera and Hemiptera, and the Coleoptera (except the Curculionidæ; possibly the Cerambycidæ and Buprestidæ, which approach the maggot-like form of the larvæ of weevils). On the other hand, taking the caterpillar or bee larvæ, with their cylindrical fleshy bodies, in most respects typical of larval forms of the Hymenoptera, Lepidoptera, and Diptera, as the type of the eruciform larva," &c.

At first sight it would appear that Mr. Packard's conclusions differ widely from those which I have advocated. He rejects, indeed, the suggestion made by Haeckel that the "common stem form of all Tracheata" may be found in "Zoeaform Crustacea." It is evident, he says (p. 159), that "the Leptus fundamentally differs from the Nauplius and begins life on a higher plane. We reject, therefore, the crustacean origin of the insects." And elsewhere "we find through the researches of Messrs. Hartt and Scudder that there were highly-developed insects, such as may-flies, grasshoppers, &c., in the Devonian rocks of New Brunswick, leading us to expect the discovery of low insects even in the Upper Silurian rocks. At any rate this discovery pushes back the origin of insects beyond a time when there were true Zoëæ, as the shrimps and other allies are not actually known to exist so far back as the Silurian, not having as yet been found below the coal-measures."

But then he observes that the "larvæ of the earliest insects were probably leptiform, and the eruciform condition is consequently an acquired one, as suggested by Fritz Müller." Again, "for reasons which we will not pause here to discuss, we have always regarded the eruciform type of larva as the highest. That it is the result of degradation from the Leptus or Campodea form, we should be unwilling to admit." And once more, "The Caterpillar is a later production than the young, wingless Cockroach."

Mr. Packard had already expressed these opinions elsewhere, and as I have on the contrary suggested that the grublike, or Lindia-forms were the first to come into existence, then the Tardigrade-form, and lastly, the Campodea-form, I had supposed that our views were in direct opposition to one another: but I am glad to find from other passages that after all there is not so much difference as these passages would seem to indicate. I cannot, indeed, agree with him in his classification of Insect larvæ; he ranks the Caterpillars with the grubs and maggots of Bees and Flies, as a class for which he proposes the term "eruciform" in opposition to the "leptiform" larvæ of Orthoptera, Hemiptera, and most Coleoptera. It seems to me, on the contrary, that the two great groups are the Hexapod or Campodea-form, and the apod, grublike type, which I have proposed to call the Lindia-form. At the first glance, no doubt, the heavy sluggish Caterpillar seems to have more in common with the grub of a Bee than with the active larvæ of Coleoptera. The difference, however, is one of habit, not of type.

As regards the ancestral forms of Insects, Mr. Packard considers that "while the Poduras (p. 154) may be said to form a specialised type, the Bristle-tails (*Lepisma*, *Machilis*, *Nicolitea*, and *Campodea*) are, as we have seen, much more highly organised, and form a generalised or comprehensive type. They resemble, in their general form, the larvæ of Ephemerids, and perhaps more closely the immature Perla, and also the wingless Cockroaches. Now such forms as these Thysanura, together with the mites and singular Pauropus, we cannot avoid suspecting to have been among the earliest to appear upon the earth; and putting together the facts, first, of their low organisation, secondly, of their comprehensive structure, resembling the larvæ of other insects, and thirdly, of their probable great antiquity, we naturally look to them as being related in form to what we may conceive to have been the ancestor of the class of insects. Not that the animals mentioned above were the actual ancestors, but that certain insects bearing a greater resemblance to them than any others with which we are acquainted, and belonging possibly to families and orders now extinct were the prototypes and progenitors of the insects now known."

As regards the probable origin of this Leptus form, Mr. Packard's views are expressed in the following passage (p. 169):—"While the Crustacea may have resulted from a series of prototypes leading up from the Rotifers, it is barely possible that one of these creatures may have given rise to a form resulting in two series of beings, one leading to the Leptus form, the other to the Nauplius. For the true Annelides (Chætopods) are too circumscribed and homogeneous a group to allow us to look to them for the ancestral forms of insects. But that the insects may have descended from some low worms is not improbable, when we reflect that the Syllis and allied genera of Annelides bear appendages consisting of numerous joints; indeed, the strange *Dujardinia rotifera*, figured by Quatrefages, in its general form is remarkably like the larva of Chloëon."

Moreover, though Mr. Packard says that "the caterpillar is a later production than the young wingless, cockroach," he elsewhere (p. 182) says, "it is evident that in the

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* Being a chapter from "Our Common Insects," by A. S. Packard, jun. (Printed in advance.)

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young grasshoppers the metamorphoses have been passed through, so to speak, in the egg, while the bee larva is almost embryonic in its build." Mr. Packard admits then that theoretically the Orthoptera do pass through transformations similar to those of metamorphic insects; though, while bees are hatched in an early larval, "almost embyonic" condition, Orthoptera pass through these early stages rapidly, and within the egg.

Mr. Packard then derives the various groups of Insecta as I do from ancestors more or less resembling the hexapod larvæ of Neuroptera, &c.; these from a more acariform type; and these again from lower, more vermiform ancestors.

That the Lindia-type larvæ *of Diptera* are of more recent origin than the Campodea-form larvæ of Neuroptera of course I admit, because the palæontological evidence seems to show that the Neuroptera are a more ancient group than the Diptera; but I am not the less of opinion that the Lindia type itself is more ancient than the Neuropterous.

How far the form of any given existing larva is adaptive and how far it is hereditary, is a comparatively minor, though interesting question, and I am glad to find that there is less difference of opinion than I had supposed between Mr. Packard and myself as to the various stages through which in the long lapse of geological ages the existing types of insects have gradually been evolved.

JOHN LUBBOCK

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*NOTES ON THE HONEY-MAKING ANT OF TEXAS AND NEW MEXICO**

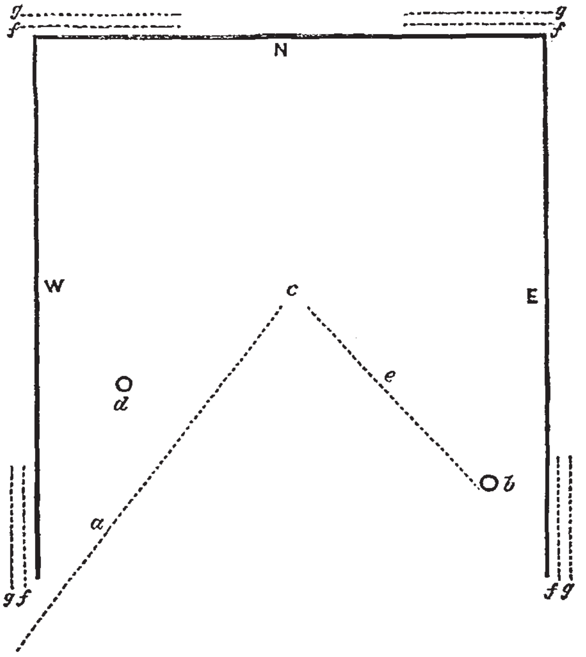
THE natural history of this very curious species (*Myrmecocystus mexicanus* Westwood) is so little known, that the preservation of every fact connected with its economy becomes a matter of considerable scientific importance, and the following observations, gleaned from Capt. W. B. Fleeson of this city, who has recently had an opportunity of studying the ants in their native haunts, may, it is hoped, be not without interest.

The community appears to consist of three distinct kinds of ants, probably of two separate genera, whose offices in the general order of the nest would seem to be entirely apart from each other, and who perform the labour allotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consist of yellow worker ants of two kinds, one of which, of a pale golden yellow colour, about one-third of an inch in length, acts as nurses and feeders of the honey-making kind, who do not quit the interior of the nest, "their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge into prepared receptacles, and which constitutes the food of the entire population. In these honey-seeking workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea." The third variety of ant is much larger, black in colour, and with very formidable mandibles. For the purpose of better understanding the doings of this strange community, we will designate them as follows:—

No. 1.—Yellow workers; nurse and feeders.
No. 2.—Yellow workers; honey-makers.
No. 3.—Black workers; guards and purveyors.

The site chosen for the nest is usually some sandy soil in the neighbourhood of shrubs and flowers, and the space occupied is about from four to five feet square. Unlike the nests of most other ants, however, the surface of the soil is usually undisturbed, and but for the presence of the insects themselves, presents a very different appearance from the ordinary communities, the ground having been subjected to no disturbance, and not pulverised and rendered loose as is the case with the majority of species.

The black workers (No. 3) surround the nest as guard or sentinels, and are always in a state of great activity. They form two lines of defence, moving different ways, their march always being along three sides of a square, one column moving from the south-east to the south-west corners of the fortification, while the other proceeds in the opposite direction. In most of the nests examined by Captain Fleeson, the direction of the nest was usually towards the north; the east, west and northern sides being surrounded by the soldiers, while the southern portion was left open and undefended. In case of any enemy approaching the encampment, a number of the guards leave their station in the line and sally forth to face the intruder, raising themselves upon their hind tarsi, and moving their somewhat formidable mandibles to and fro as if in defiance of their foe. Spiders, wasps, beetles, and other insects are, if they come too near to the hive attacked by them in the most merciless manner, and the dead body of the vanquished is speedily removed from the neighbourhood of the nest, the conquerors marching back to resume their places in the line of defence, their object in the destruction of other insects being the protection of their encampment, and not the obtaining of food. While one section of the black workers is thus engaged as sentinels, another and still more numerous division will be found busily employed in entering the quadrangle by a diagonal line bearing north-east, and carrying in their mouths flowers and fragments of aromatic leaves which they deposit in the centre of the square. A reference to the accompanying sketch will give a more clear understanding of their course; the dotted line *a* representing the path of this latter section, while the mound of flowers and leaves is marked *c*. If the line *a* be followed in a south-west direction, it will be found to lead to the trees and shrubs upon which another division of the black workers is settled, engaged in biting off the petals and leaves to be collected and conveyed to the nest by their assistants below. On the west side of the encampment is a hole marked *d* leading down to the interior of the nest, which is probably chiefly intended for the introduction of air, as in case of any individuals carrying their loads into it, they imme-



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* By Henry Edwards, Californian Academy of Sciences. Communicated by Mr. Charles Darwin, F.R.S.

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